MA801  FUZZY LOGIC AND NEURAL NETWORKS  4-0-0-4

Classical sets & Fuzzy sets- Crisp sets- an overview, Fuzzy sets-Basic types and concepts; Fuzzy sets versus Crisp sets – Additional properties of \( \mu \) cuts – Representations of Fuzzy sets – Extension principles of Fuzzy sets; Operations on Fuzzy sets – Types of operations – Fuzzy complements – Fuzzy intersections-norms – Fuzzy unions: t-Conorms – Combinations of operations – Aggregation operations.


Fuzzy systems; Pattern recognition; Engineering Applications- Civil, Mechanical, Industrial, and Computer Engineering, and Reliability theory and Robotics.


TEXT BOOKS/ REFERENCES:


MA802  PROBABILITY AND APPLIED STATISTICS  4-0-0-4


Hypothesis Testing and Statistical Quality Control: Testing of hypothesis – type-I and type-I errors and critical region – Normal, t, F and Chi-square based tests – p-value - nonparametric tests – sign test, signed rank test and run test. Analysis of variance – one-
way and two-way ANOVA – multiple comparison tests – statistical quality control –
control charts for variables and control charts for attributes.

TEXT BOOKS / REFERENCES:

   2012.
3. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and
   Keying Ye, “Probability and Statistics for Engineers and

MA803   FOURIER TRANSFORM AND WAVELET TRANSFORM   4-0-0-4

Fourier Transforms: Fourier Integral Representations - Proof of The Fourier Integral
Theorem - Fourier Transform Pairs - Properties of The Fourier Transform - Transforms of
More Complicated Functions - The Convolution Integrals of Fourier - Transforms
Involving Generalized Functions - Hilbert Transforms - Introduction- Discrete Fourier
Transformation.
Continuous Wavelet Transform : Introduction-Continuous-Time Wavelets- Definition of
the CWT-The CWT as Correlation-Constant Q-Factor Filtering Interpretation and Time –
Frequency Resolution -The CWT as an Operator-Inverse CWT-Problems
Discrete Wavelet Transforms: Introduction-Approximations of Vectors in Nested Linear
Vector Subspaces –Example of Approximating Vectors in Nested Subspaces of a Finite-
Dimensional Linear Vector Space-Example of Approximating Vectors in Nested
Subspaces of a Infinite- Dimensional Linear Vector Space –Example of an MRA-Bases
for the Approximation Subspaces and Harr Scaling Function –Bases for the
Approximation Subspaces and Harr Scaling Function-Bases for the Detail Subspaces and
Harr Wavelet

TEXT BOOKS / REFERENCES:

1. Larry C. Andrews and Bhimsen K. Shivamoggi, “Integral Transforms for

Tree: Tree, properties of Trees, distances and centers in a tree, spanning tree, Fundamental Circuits, minimal, maximal spanning tree-rooted binary trees. Vertex and Horizontal constrained graphs, interval, permutations and intersection graphs with simple properties.

Computational Complexity: Introduction to NP completeness, the classes of P and NP, Tractable and Intractable algorithms, Cooks theorem.


TEXT BOOKS / REFERENCES:


MA805 STATISTICAL INFERENCE AND DESIGN OF EXPERIMENTS 4-0-0-4

Point and Interval Estimation: General concepts - unbiased estimators - Variance and mean square error of an estimator - Methods of point estimation - Confidence interval development for population parameter – mean, variance, proportion – small and large sample cases – Bayes interval estimation.

Tests of Hypotheses: Hypothesis testing – general procedure for hypothesis testing – power of a test –alpha and P-values, choice of sample size, application of various test statistics with the respective distributional properties.

Analysis of Variance and Design of Experiments: Design and analysis of single-factor experiments – model development of completely randomized experiments – multiple comparisons – Randomized block designs – Tests and assumptions based on fixed and random effects models – Design of experiments with several factors – Factorial experiments – General factorial experiments – $2^k$ factorial experiments – Blocking and confounding – Response surface methodology – Orthogonal experiments.
TEXT BOOKS/REFERENCES:


MA806 REGRESSION ANALYSIS 4-0-0-4


TEXT BOOKS / REFERENCES:


Non-Linear Stationary Models: Introduction-Three explicit forms for the ARIMA Model-Integrated Moving Average process.

Forecasting: Principles of forecasting-Forecast based on an infinite number of observations –Forecast based on a finite number of observations –the triangular factorization of a positive definite symmetric matrix-updating a linear projection-optimal forecasts for Gaussian processes-sums of ARMA processes-Wold’s decomposition and the Box Jenkins modeling

**TEXT BOOKS /REFERENCE S:**


TEXT BOOKS /REFERENCE


MA809 ADVANCED ALGEBRA 4-0-0-4

Structure of Finite Fields: Characterization of Finite Fields, Roots of Irreducible polynomials Traces, Norms and Bases, Roots of Unity and Cyclotomic Polynomials, Representation of Elements of Finite Fields.
Permutation Polynomials: Criteria for Permutation Polynomials, Special Type of Permutation Polynomials, Groups of Permutation Polynomials, Exceptional Polynomials, Permutation Polynomials in several indeterminate.

TEXT BOOKS / REFERENCES:


MA810 COMPUTER AIDED DESIGN OF VLSI CIRCUITS 4-0-0-4

Placement, Partitioning and Floor Planning: Types of Placement Problems – Placement Algorithms – K-L Partitioning Algorithm. Optimization Problems in Floor planning - Shape Function and Floor plan Sizing
TEXT BOOK / REFERENCES:


MA811 FUNCTIONAL ANALYSIS

Metric Spaces, Vector Spaces: Metric Spaces, Examples of Metric Space, Vector Spaces, Examples of Vector Spaces, Subspaces, Linear Independence, Basis and dimension, Cauchy sequence, Convergent sequence, Complete Metric Space.
Normed Linear Spaces, Banach Spaces: Normed spaces, Properties of Normed Spaces, Banach Spaces, Compact Space, Linear operators, Linear functional, Normed Spaces of operators, Dual Spaces.
Applications: Banach fixed point theorem, Application of Banach’s theorem to linear equations, Differential Equations and Integral Equations-Approximation in Normed Linear Spaces, Strict convexity, Uniform approximation. Chebychev’s polynomials, Approximation in Hilbert space and splines.

TEXT BOOKS / REFERENCES:


MA812 TENSOR ANALYSIS AND FINITE ELEMENT METHODS

Introduction to Vector and Tensor analysis: Vectors – Vector Spaces - Tensors - Differential forms – Variational principles – n\textsuperscript{th} rank tensor in m dimensional space – Cartesian Tensors -Theory and applications to geometry and Mechanics – Tensor analysis on manifolds.
Introduction to FEM: General procedure for finite element analysis - Types of finite elements in one, two and three dimensions - Shape functions, Interpolation functions for general finite element formulation - Convergence criteria, compatibility requirements, geometric isotropy invariance.

Solution Techniques: Numerical integration – Gaussian quadrature – Wilson 0 method
Direct methods – Gauss elimination method, Choleski decomposition, frontal method
Iterative techniques – gradient based methods and preconditioners - Eigen Values

TEXT BOOKS /REFERENCES:


MA813 NETWORK ON CHIP 4-0-0-4

Graph terminologies – Types of Graphs- Graph Algorithms: Shortest Path-Maximal Flow-Minimal Spanning Tree-Graph Partitioning.
Introduction to NoC-SoC objectives and NoC needs-Network Architecture for on chip relations-Ad HOC Network Architectures-Component Design for NoCs-Properties of Network Architecture.
Physical Network Layer: Interconnection in DSM SoC-High performance Signaling-Building Blocks.
Network and Transport Layers in NoC: NoC QoS-NoC Topology-Switching Techniques-NoC Routing-NoC Addressing-Congestion and Flow control.
NDesign Methodologies and CAD Tol Flows for NoCs: Network Analysis and Simulation-Network Synthesis and Optimization-Design flow for NoC.

TEXT BOOKS / REFERENCES


**TEXT BOOKS / REFERENCES:**


**MA815 MATHEMATICAL THEORY OF MAGNETOHYDRODYNAMICS**

TEXT BOOKS / REFERENCES:


MA 816 GEOPHYSICAL FLUID DYNAMICS 3-0-0-3


TEXT BOOKS /REFERENCES:


MA817 ADVANCED BOUNDARY LAYER THEORY 4-0-0-4

Introduction – limitations of ideal fluid dynamics – Importance of Prandtl’s boundary layer theory - boundary layer equations in two dimensional flows – boundary layer flow over a flat plate – Blasius solution – Boundary layer over a wedge – energy integral equation for two-dimensional laminar boundary layers in incompressible flow – application of Von Karman’s integral equations to boundary layer with pressure gradient Displacement, momentum, energy thickness – axially symmetric flows – momentum equation for laminar boundary layer by von Karman – Wall shear and drag force on a flat

**TEXT BOOKS /REFERENCES:**


**MA818  GENERALIZED MATRIX FUNCTIONS  4-0-0-4**


Matrices: Matrices of 0’s and 1’s, lower and upper bounds for permanent of (0, 1) matrices, Non-negative, positive definite, doubly stochastic matrices, and Hermitian matrices.

Multilinear Algebra: Generalized Cramer’s rule, Generalized inverse, diversity of generalized inverses, Jordan and Smith normal forms. Moore-Penrose inverse, \{1\}, \{1,2\}, \{1,2,3\} inverses, and Bott-Duffin Inverse.

**TEXT BOOKS/REFERENCE BOOKS:**

MA 819  VECTOR BUNDLES  4-0-0-4


TEXT BOOKS / REFERENCES:

MA 820  THEORY OF MANIFOLDS  4-0-0-4


TEXT BOOKS / REFERENCES:

MA 821  LIE ALGEBRAS  4-0-0-4


**TEXT BOOKS / REFERENCES:**

**MA 822 LIE GROUPS 4-0-0-4**


**TEXT BOOKS / REFERENCES:**

**MA 823 REPRESENTATION THEORY OF LIE ALGEBRAS 4-0-0-4**


**TEXT BOOKS / REFERENCES:**

MA824 SPECTRAL GRAPH THEORY AND ITS APPLICATIONS  3 0 0 3

Adjacency matrix and Laplacian, Intuition, spectral graph drawing, Physical intuition Isomorphism testing.
Random walks. Graph Partitioning and clustering, Distributions of eigenvalues and compression, Computation.
Energy minimization.
Randomized algorithms and Markov chains. Construction of expander graphs.

TEXT BOOKS / REFERENCES:


MA825 THEORY OF HYPERGRAPHS  4-0-0-4

**Hypergraphs:** Basic Concepts.- First Definitions, Simple Reduction Hypergraph Algorithm, Algebraic Definitions for Hypergraphs, Matrices, Hypergraphs and Entropy, Similarity and Metric on Hypergraphs, Hypergraph Morphism; Groups and Symmetries, Generalization of Hypergraphs.

**Graphs versus Hypergraphs:** Graphs, Graphs and Hypergraphs, Intersecting Families, Helly Property, Subtree Hypergraphs, Conformal Hypergraphs, Stable (or Independent), Transversal and Matching, König Property and Dual König Property, linear Spaces.

**Some Particular Hypergraphs:** Interval Hypergraphs, Unimodular Hypergraphs, Balanced Hypergraphs, Normal Hypergraphs, Arboreal Hypergraphs, Acyclicity and Hypertree Decomposition, Planar Hypergraphs

**Reduction-Contraction of Hypergraph:** Introduction, Reduction Algorithms-Generic Algorithm, A Minimum Spanning Tree Algorithm (HR-MST).


- Domination, Independence and irredundance: Hereditary and super hereditary properties
- Independent sets – dominating sets – irredundant sets – domination chain: integer sequence and domination sequence, edge independence, domination, and irredundance – mixed independence, domination and irredundance – Fractional domination and irredundance

Changing and unchanging domination: relationships among classes. Conditions on dominating set: Total open dominating sets, independent dominating set, connected dominating set, dominating cliques, paired dominating sets, dominating cycles.

- Varieties of dominations: Multiple domination, parity restriction, locating domination, distance domination, strong and weak domination, global and fractal domination, domination in directed graphs. Multiset and multi-property parameters: Prioritized multiproperty problems and sequential problems, domatic number.

- Sums and products of parameters: Nordhaus-Gaddum type results, domination and chromatic number. Dominating functions: Minus and signed domination, Y–dominating parameters, Complementarity.

- Frameworks for domination: Hyper graphs, Matrices of 0’s and 1’s, Fundamental dominating sets, conditions on dominating sets.

Text books / References:

**MA827  FRACTIONAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS**  

**Fractional Calculus:** Study of basic functions – Gamma function, Mittag-Leffler function, Hypergeometric function, fractional calculus a generalization of integer order calculus.

**Fractional derivatives and Integrals:** Definition of fractional derivatives and integrals- Riemann-Liouville, Caputo and Grunwald-Letnikov, and their relations, properties of fractional derivatives, computation of fractional derivatives for some basic functions like constant, exponential, log, sine, cosine, Laplace transform of Riemann-Liouville, Caputo and Grunwald-Letnikov derivatives.

**Properties of Differintegration:** Linearity, differintegration term by term, homogeneity, scale change Leibniz’s rule, chain rule.

**Differintegration of simple functions:** Differintegrable functions-unit function, zero function, function of \((x-a)\), function \((x-a)^p\), Binomial function, exponential functions, Heaviside and Dirac functions.

**Fractional Differential Equation (FDE):** Solving homogeneous FDEs- direct approach, Laplace transform approach, linear independent solutions, solving fractional integral equations, short memory principle, law of irreversibility nonlocality.

**Applications of Fractional Calculus:** Able’s fractional integral equation- the Tautochrone problem, fractional damped motion, semi-infinite line in circuits -semi-differentiator circuit.

**Reference:**

**MA828  STOCHASTIC DIFFERENTIAL EQUATIONS**  

**Introduction:** Deterministic and random differential equations, stochastic differential, Ito’s chain rule.

**Probability Theory:** Basic definitions, expected value, variance, independence, some probabilistic methods, law of large numbers, central limit theorem, conditional expectation, martingales.

**Brownian Motion:** Definition, elementary properties, construction of Brownian motion, sample path properties, Markov property.
**Stochastic Integrals:** Ito’s Integral, Ito’s chain and product rules, Ito’s integral in higher dimensions.

**Stochastic Differential Equations:** Existence and uniqueness of solutions, properties of solutions, linear stochastic differential equations.

**TEXT BOOKS / REFERENCE BOOKS:**